THE AMERICAN ARCHITECT AND BUILDING NEWS.

VOL. II.] Copyright, 1876, JAMES R. OSGOOD & CO. [NO. 94.

BOSTON, OCTOBER 13, 1877.

CONTENTS.

SUMMARY:—
The Injury to the Patent Office.—Report of the Committee.—The New Iowa State-House.—Cost of the Building.—A Schoolhouse in New York.—The Fallen Stand in Boston.—The Alexandrian Obelisks 325
HATFIELD'S TRANSVERSE STRAINS 326
THE VENTILATING AND WARMING OF SCHOOLHOUSES IN THE NORTHERN UNITED STATES. II. 327
THE ILLUSTRATIONS:—
Store in Cincinnati, O.—House at Hartford, Conn.—Details of the School of Fine Arts at Marseilles, France. 330
THE PARIS MASON 330
CORRESPONDENCE:—
Letter from St. John, N.B. 330
THE SOOCHOW PAGODA 331
LINCOLN CATHEDRAL 331
NOTES AND CLIPPINGS 332

THE elements seem to have conspired against the Patent Office. The storm of last week, coming while the injured half of the building was yet unroofed, seems to have done as much damage as the fire itself. The tremendous rain made its way through both the upper floors in streams, drowning out the first and second stories, destroying the ceilings, ruining carpets and furniture, and doing great injury to books and papers. The marble ceiling of the north portico crumbled and fell upon the granite steps, which were broken by it, showing that the heat of the fire had partly calcined it into lime, which, slacked by the rain, crumbled away. It is a curious instance of the way in which the records of public buildings are lost or forgotten, that the manner of construction of the Patent Office was unknown till the fire and the storm revealed it. The falling of the ceilings in the north wing after the rain showed that not only was the lathing and furring of wood, but the floors themselves in that wing, though overlaid with marble slabs, were of timber. They had been believed to be of iron and brick like the others, and their preservation from the fire was ascribed to these materials. It is more than likely that but for this last accident the building might have been restored with these floors untouched, and ready to surprise the inmates some day by a second conflagration. The discovery has its useful side, for it shows how much fire from above the wooden floor will bear when covered with stone.

THE authorities have been sharply criticised for not putting the building under some kind of temporary roof at once, instead of allowing it to wait uncovered ten days for a storm. The answer of the department is, that a temporary roof laid over the walls of the building could not well be secured against violent winds, and that to put on a roof inside the walls requires a careful removal of rubbish and of iron beams which are bedded in the walls; all of which, being necessarily done by hand, for derricks cannot be trusted on the floors, is slow work. This is all reasonable, yet it is about as difficult to make an inside roof secure against rain as an outside one against wind; and if the occasion were to occur again, we are disposed to think that the outside roof would be got on as quickly as possible. Of course the disorder in the department is worse than ever, and the condition of the building is lamentable. It is so thoroughly water-soaked that it would take weeks of artificial drying to make it safe for occupation; whereas orders had already been issued to make no fires in the building, from fear that the flues had been made unsafe. The committee appointed to examine the building — Gen. Meigs, Mr. Clark, and Mr. Cluss — had reported that the walls were strong, and that when re-roofed it would be secure and substantial. Whether, after the second disaster, they will see reason to report differently, remains to be seen. If the drenching had occurred a little later, in the season of hard frosts, the exposed part of the building might have been torn to pieces; as it is, there is not much danger from this source. The committee recommend that the new roof shall be of iron and covered with copper. They suggest also that for the sake of giving more space, a cross-wing be added, which will divide the interior court, and that the two smaller courts thus formed be glazed, and used for model-rooms. Inasmuch as before the fire the building could not house the whole department, the suggestion seems timely.

THE financial administration of the Iowa State Capitol would seem to be an example for neighboring States. According to the correspondent of the Chicago *Tribune*, every year's work on the building, which has been in progress since 1870, has closed with an unexpended balance of appropriated money on hand; and the last report of the commissioners, to Sept. 1, 1877, shows a balance of nearly $34,500. The most satisfactory feature to the tax-payers must be, we should think, that the whole has been paid for out of annual taxes, so that nothing whatever has been added to the State debt by the building, — a state of things for which posterity, which will unquestionably have burdens enough of its own assuming to bear, will doubtless be profoundly thankful. How much this successful management may have been due to the slowness with which the work has been carried on, — it was begun in 1870, and has now only in part reached the level of the roof-plate, — or how much it may have occasioned it, we have no means of knowing; but any community may well be content to accept a slow rate of progress, which leaves such clean work behind it. The building was not very fortunate at the beginning; for the work of the first year, and of the first board of commissioners, was thrown away, the foundations being utterly ruined by the winter's frost. The foundation and the commissioners were removed in 1872 at a cost of between fifty-two and fifty-three thousand dollars and the delay of a season, since when there has been no difficulty. It is to the credit of the legislature, that when the original design had for economy's sake been marred by the substitution of cast-iron capitals and galvanized cornices for stone, it ordered the restoration of the proper materials. The first architects of the building were Messrs. Cochrane and Piquenard, the architects also of the Illinois Capitol. With the change of commissioners Mr. Cochrane resigned, leaving the work in sole charge of Mr. Piquenard, on whose death last year Messrs. Bell and Hackney, the present architects, were appointed.

THE original estimate of the cost of the building was a million and a half of dollars; of which a million and a quarter have already been appropriated, and as we have seen, nearly exhausted, while the building is but just reaching its roof. The commissioners have, however, not as yet substantially increased their estimate. Neither of the estimates has included the cost of the dome, which is regarded, at least in the Western States, as the indefeasible right of a State House, and which has always in imagination been part of the design. The detailed account of expenditures furnished by the commissioners, as we find it in the *Tribune*, is not arranged in such a way as to be instructive or very intelligible; but we pick out and sum up from it the items of $380,000 (round numbers) for stone, $260,000 for dressing it, and $50,000 for setting; $160,000 for bricks, and laying them; $46,000 for mortars, concrete, and their materials, mostly cement; $64,000 for wrought iron, and $2,000 for cast iron. It is not our business to inquire into the compensation of the architects, but it is not without surprise that we note the item of $4,100 for plans, about one-third of one per cent on the money thus far expended. It may be assumed that the greatest part of the architects' compensation is included under the item, "salaries $61,432," the expenses of the commissioners being separately stated as $14,074. We presume the tax-payers of Illinois, and especially of Chicago, will find something to interest them in the success with which neighbors have managed their public building.

A SORRY case of negligence among the New York school authorities has come to light. It would appear that a schoolhouse in one of the poorer districts of the city has long been in a most deplorable condition, without receiving any attention from the Board. It adjoins a filthy tenement-house so

closely that the smells from the house are sickening to teachers and scholars; and it has been necessary to use disinfectants to make the schoolrooms habitable. The building has no cellar, and the rooms are so shut in and darkened that on cloudy days they have to be lighted with gas. When the building was opened after this summer's vacation, it was found that in the lower rooms the floors, walls, and desks were covered with green mould. The Board of Education have been obliged to undertake to put the building in repair, though it is a little hard to see what repairs can meet such a difficulty. Meanwhile teachers and scholars, we are told, have had to abandon the school again and again, sickened by its noxious exhalation, till one of the teachers has died of consumption, and another has fallen ill of typhoid fever; and who is to repair this? It is said by the Board, that the school-funds are not enough to provide schooling for all the children in New York; a matter not so much to be regretted if this is the kind of accommodation that the Board furnishes. One may lawfully infer from the present condition of things, we should think, that the Board has already more schools on its hands than it can properly attend to; and then the political duties of New York officials, as is well known, are very exacting.

The committee of the Boston City Government, appointed to examine into the fall of a scaffold at the dedication of the Soldiers' Monument in that city, have rendered their report, which is plain, decisive, and reasonable, as far as it goes. A considerable part of the report is taken up with considering who was, from the city's point of view, the responsible builder of the stand, — a question which is of no general interest, except as it indicates a loose way of doing business on the part of the city officers. The conclusions of the committee are, that the accident was due to unworkmanlike construction of the seats; that the builder of the stands is responsible for their defective construction; and that the Inspector of Buildings who visited the stands, and the assistant inspectors who inspected them, did not use sufficient care. "Responsible," in the view of the committee, undoubtedly means simply guilty; but there is another meaning for the word, which is here as important to the public as the first, — perhaps more important. It belongs to the person from whom redress is to be had, if redress is called for, or on whom penalty is to be visited. In this sense, is Mr. Paul, who is declared to be the builder, responsible to the city, and the city to the persons who have been maimed? or is Mr. Paul directly responsible to these persons? or are the committee who ordered the stands responsible to one or the other? and is the chief inspector answerable to the city for the acts of his subordinates, and they to him? or do they answer directly to the city? And, finally, to what extent will this responsibility be enforced? or will nothing be done in case the victims decide to nurse their hurts in quiet?

Mr. Wilson's Alexandrian obelisk is now fairly afloat, after between two and three months' labor under direction of the engineer, Mr. Dixon, who had engaged to superintend its transportation. The cylindrical iron casing (of boiler-plate) in which it is to be floated to England was built around it while it lay on the sand; and ways of stone were laid, on which to roll it to the sea, the casing being protected by wooden tires or jackets bound around it where it was to bear upon the ways. The obelisk is hung eccentrically in the cylinder, to prevent its rolling over and over in the water; but the mass was temporarily counterbalanced by a loading of railroad iron on the lighter side, that it might roll on land. Urged by jack-screws, and dragged by steam tugs in the water, the cylinder was in a long day's work rolled to the water's edge. Much pains had been taken to clear the shore, and the bottom over which it was to be rolled; but when the second day's effort had forced it out into somewhat deep water, it was found to be full, and examination by a diver showed that an unnoticed stone had been forced through the shell, and made a hole half a yard across. It took a week's labor to turn the cylinder into such a position that the hole was uppermost, and could be mended, and to empty and float it. Then the wooden jacketing was stripped off, the iron counterpoise removed, and the structure floated in its proper position, drawing eight feet at one end, and ten at the other, with a displacement of two hundred and eighty tons. This was the condition of things on Sept. 8, after which, as we understand it, the craft was to be decked and rigged in some sort for its voyage to England, in tow of a merchant steamer, for which a three and a half inch steel wire hawser is provided. Meanwhile there is considerable discussion in London, as to where it had best be put; most people apparently favoring some position on the Thames Embankment, but authorities — or projectors — by no means agreeing. It is now said that there is a chance of having the companion obelisk in New York. The newspapers tell us that the Khedive is willing to present Cleopatra's Needle to the city of New York, if she will ask for it and bring it home. The men who are now bringing the Wilson obelisk to England offer to bring the other to New York in the same way for a hundred thousand dollars, at their own risk; and Mr. Charles Storrs has proposed to bear one-fiftieth of the expense, if the remainder can be provided for.

HATFIELD'S TRANSVERSE STRAINS.[1]

At a time when our public is just awaking, under pressure of disaster, to the necessity of intelligent construction in buildings and of proper theoretical training for constructors, the publication of a treatise on construction, especially intended for architects, is very seasonable. Such theoretical knowledge of construction as is needed for ordinary exigencies is by no means abstruse; yet a great many of our architects, we are ashamed to say, have none of it, while those who acquire it during their preliminary studies are too apt to neglect it till it grows very rusty. Mr. Hatfield's book is almost if not quite the only work of the kind in the language, — the only one, so far as we know, that is specially adapted to the wants of the architect. The accessible books — those which had any serious pretension — have been general treatises on statics, or books which passed by the ordinary problems of the architect for the more complicated ones of the engineer, or else books on the practical mechanism of building rather than its mechanics.

This work undertakes to give the architect just what he needs. It is written throughout with intent to make it a thorough treatise for the student and a useful book of reference for the practitioner. It does not cover the whole ground of the theoretical construction of buildings; being limited, as its title indicates, to those parts of his work which deal with transverse stress, — floors, roofs, girders, trusses, etc. But the ground it proposes to cover is very thoroughly examined, and the American reader will find that the problems to which the methods of building that are in use here give rise have been very fully considered. The book is not without the interest which is due to independent investigation, for the tables appended to it are new; many of the problems discussed, though familiar in practice, are new to the books; and in many cases the well-known principles are enforced by the record of new experiments.

The book begins with the discussion of the most elementary principles, and gradually develops them into higher applications. The method of moments is introduced as "the application of the lever principle," a condescension to the unlearned which perhaps was hardly necessary. The graphical method is constantly used, even for simple solid beams, which is probably judicious, considering the development which this method has lately received and the importance of making the student well acquainted with it. We have first the theory of beams under transverse pressure, with concentrated, multiplied, or distributed load. The theory is then applied to girders and floor beams; and the loading and dimensions of floors, both in dwelling-houses and warehouses, are studied in the light of some new experiments, of which the most interesting concern the weight and movements of the live load to which ordinary floors are subjected. The problems are treated with reference both to rupture and deflection, by both algebraic and graphical methods, and for floors both of wood and iron. The discussion is extended

[1] Theory of Transverse Strains, and its Application in the Construction of Buildings; including a full discussion of the theory and construction of floor beams, girders, headers, carriage beams, bridging, rolled-iron beams, tubular-iron girders, cast-iron girders, framed girders, and roof trusses; with tables, calculated and prepared expressly for this work, of the dimensions of floor beams, headers, and rolled-iron beams; and tables showing results of original experiments on the tensile, transverse, and compressive strengths of American woods. By R. G. Hatfield, Architect. Fellow American Institute of Architects; Member American Society of Civil Engineers; author of American House Carpenter. New York: John Wiley & Sons, 15 Astor Place. 1877.

to cast-iron girders as well as wrought iron, and to tubular girders. Considerable space is given to the consideration of trussed girders and roofs. The work closes with a series of useful tables computed from experiments by the author. They give sizes of beams needed for floors of various spans in dwelling-houses and warehouses, for the various woods commonly used in framing — hemlock, spruce, Georgia pine, and white pine, — and for rolled-iron beams of four different manufactures; also the various data concerning the resistance of the different woods to transverse rupture, deflection, tension, and crushing, and to rupture by sliding or detrusion in cases of notched beams, treenailing, etc.

The execution of the work seems to be remarkably well considered and thorough. Its purpose has been not merely to present a book of handy reference, of which there are already several to be found, but a systematic treatise, which shall put its reader in possession of its subject, and treat fully the topics which it aims to include. The matter is arranged with care and judgment, for clearness of development to the student, while ease of reference to the professional man is not forgotten. With a view to this latter service, the book is provided with two tables of contents, and a very full index, — a matter of great importance in a work of this kind, but too often neglected. Special reference is further facilitated by the addition of what the author calls a directory, — a kind of digest of the topics considered, tabulated in full but compact form. The style is very simple, clear, and straightforward; and everywhere an effort is made to avoid unnecessary abstruseness. As a literary criticism, we are inclined to object to an occasional neglect of symmetry in the notation used, a quality which has more than an ornamental use.

There are cases in which apparently the author's desire to lay few principles and a uniform method before the student has led him away from solutions more compact than those he has actually employed. Thus the graphical method for two or more loads is shown by drawing a diagram of strains for each load, then, by adding the strains at any given point made by each separate weight, the total strain at the point is obtained. This is of course correct; but by laying off the weights by scale, assuming a pole, and drawing a funicular polygon, the strains would be determined in a simpler manner, especially if there are many loads to be considered. The discussion of the bridging of floors is an interesting point, and is original with the author, we presume; but we notice that the demonstration on p. 305 depends on the unexplained assumption that the three points A, E, and C are in the same straight line: a condition which no one would be inclined to take for granted. Singularly enough, the one experiment cited by Mr. Hatfield, which bears upon the point, confirms this unexpected assumption, the differences in the successive deflections being 0.192, 0.191, and 0.192 inches. But we cannot help regarding this behavior of the model as exceptional, and unlikely to be borne out in actual experience. The advantages of bridging are clearly shown; but one thing worth adding is, that it should not run up to a joist running along and against a brick wall. Bridging has a tendency to act like a scissors or lazy-tongs, and we have seen a wall pushed out an inch or more by it, especially after a shower and before the roof is on; the rain and sun causing the joists to swell and shrink.

In speaking of carriage beams it is said that as the header "is a concentrated load at the point of connection, all mortising should be avoided," and the support given by bridle or stirrup-iron. This is quite true, yet we have seen some instances where the header was tenoned into the carriage beam, and a stirrup-iron put on also: the result being not only that the carriage beam was weakened, but the tenon of the header carried the weight, and the stirrup-iron hung loose, and carried nothing. In speaking of mortising headers, it is said that the mortise should be confined to the middle of the height, which is correct; the usual practice, however, which is to the contrary, two mortises being made one above another, has the advantage of steadying the tail-beams, when the header is abundantly strong.

The subject of frame-girders and roof-trusses is treated at considerable length; the graphical method is used; and here the funicular polyglon is introduced, though we think it might well have been carried farther. The loads in all cases are taken as vertical, which is sufficient for flat roofs; but when the roof is steep the force of the wind should be taken into consideration. In such a case a truss usually has vertical loads on one-half of it, inclined loads, greater than the previous ones, on the other half, and symmetrical and vertical loads on the tie-beam (unless when it is an open-timbered roof). These might all be combined together, the reactions at supports determined by the funicular polygon, and then the strains in the members are readily ascertained. An ingenious, and as we have never before seen it, we presume an original method, of determining the reactions at the supports of a truss is given, though here too all the loads are vertical. We notice that Mr. Hatfield's analysis of trussed girders, though minute and complete, is confined to a single form of truss (that sometimes called the Warren truss), consisting of a series of simple isosceles triangles. The investigation of other forms is left to the reader; but it might have been an advantage to introduce one or more of the commoner forms with at least a suggestion of the method of analyzing them. In the few instances in which the calculus is introduced, it might have been confined to foot-notes or an appendix. Its appearance may frighten some people; but it may be skipped if desired, for it is always used for an alternative.

A book which begins at the very beginning of such a subject, and undertakes to develop the whole of it from first principles, exposes itself to a pretty severe logical test. It is extremely difficult to compress the antecedent theory of the action of forces into the dimensions which introductory chapters require, and to display it in a form to suit the untrained reader, without either falling into assumptions which are not logically warranted, or slurring steps in the development here and there in a way which the experienced reader will notice, though the student may not be troubled by it. The work is made much easier and safer for the author, and for qualified readers the result is more satisfactory, if the abstract preliminaries can be taken for granted and simply introduced in formulæ. Thus Mr. Hatfield's book would have gained in literary form and technical elegance if he had taken his elementary discussion of forces for granted from the beginning, as he does subsequently the principle of the polygon of forces. On the other hand, since some understanding of the action of statical forces is absolutely indispensable to the comprehension of the book, and considering that architectural students are always in haste and impatient of any thing more than what they want for immediate use, we think that Mr. Hatfield is right and his book more useful as it is, and that persons who might use the book if it stood alone would shrink from it if it were weighted with the requirement of special previous study.

As it stands, those who have a fair understanding of the subject will find this work easy and interesting reading, and extremely useful for reference; those who wish for such an understanding will find it certainly not a book to be mastered without labor, but probably the best and most direct means at their disposal for acquiring what they need. It is to be wished, for the sake of our profession, that every student who proposes a serious study of architecture could be required to qualify himself by the mastery of this book or its equivalent; and we know of no book which provides the equivalent in a form so well suited for the architect's wants.

THE VENTILATING AND WARMING OF SCHOOL-HOUSES IN THE NORTHERN UNITED STATES.

BY DR. F. WINSOR OF WINCHESTER, MASS.

II.

Read at the meeting of the Social Science Association at Saratoga, Sept. 6, 1877.

TEMPERATURE OF THE ROOM.

WHAT is the proper temperature for a schoolroom?

Without attempting to fix any one absolute temperature, we may confidently assert that in the United States the general tendency is to keep it from 2° to 6° too high, or not seldom from 8° to 10° above what is most wholesome, and also most agreeable to healthy sensations. In a pure air, in a room properly ventilated, most adults are more comfortable at a temperature between 64° and 68° Fah. than at a greater heat; and children (of the legal school age) are probably comfortable at a temperature somewhat lower. They certainly seem so, and it is very desirable that they should not be trained to require more heat than is necessary. Such a demand is in itself an evil, impairing the comfort, the spirits, and the power of application of the child while in school, and exposing him to greater shock from the contrast between the tem-

perature of the schoolroom and that of the staircases, the halls, and the street. Let it be understood that we are not advocating the practice of making children hardy by exposure to discomfort, than which nothing can be more pernicious, but the practice of allowing them to sit and study in the lowest temperature at which they are comfortable, which tends to make them hardy without risk.

That the temperature named is not too low for comfort appears plain from the experience of many persons in this country, and from the general experience in England, France, and Germany, where such a temperature as is commonly maintained in our schoolrooms (70°) is considered uncomfortably warm. It is probably the case that more clothing is worn within doors in those countries than in ours, at least by girls and women, which practice will partly account for the tolerance of a lower temperature there. In this connection we may ask, why should women be less warmly clothed than men?

Allowing the proper temperature to be between 64° and 68° Fah., the question of its existence in a given room is not to be determined by sensation alone, nor by the thermometer alone, but by the joint testimony of both, and of both in *different parts of the room*. If the decision be left to the sensations of a teacher who confines himself to a seat in one part of the room, and that usually a platform somewhat above the level of the rest of the floor, it will be made with little reference to the comfort of the children; and the case will be the same if the question be referred to a single thermometer, since few rooms have a uniform temperature throughout. Several thermometers should be placed in every schoolroom; or if there are but two, they should be moved from one part of the room to another, and *studied*, till the facts with regard to the temperatures of the different parts of the room are well understood. Moreover the thermometers must have been compared and found to be in harmony, for it is by no means uncommon to find a discrepancy of 4° in ordinary thermometers, even when hanging side by side. This done, we shall be in a position to say what window, door, or wall acts as a refrigerator.

It is to be understood that whatever temperature is fixed as the standard, it is to be tested on a level with the faces or shoulders of the children, when seated, this being the level which most concerns them. And the same temperature must be preserved at the level of the floor, or not be allowed to fall more than two degrees. Otherwise the children are certain to have cold feet and to be uncomfortable, and suffer in health. Hence the importance of having floors close, thick, and non-conducting, to the greatest attainable degree. The use of paper, — or better, of plaster, — between the two layers of the floor, conduces to this end; as does also the placing of the heating apparatus in the cellar or basement. By placing the openings for the escape of foul air near the floor, much may be done to prevent the existence of a stratum of cold air around the feet; and if this plan of ventilation include the passage of the exit flues in the space between the two layers of the floor, a warm floor is theoretically secured; and it is asserted that this great advantage is really secured in many buildings, both for dwellings and schools, where the so-called "Ruttan system" has been adopted, as is the case to a considerable degree in Canada and the North-western States of this country. It is obvious that if this desideratum can be secured by downward ventilation, that method is especially valuable for rooms on the lower floor, where also it can be most readily applied. The floors of the stories above would be warm, from the very fact that there are occupied rooms beneath them.

TEMPERATURE OF HEATING APPARATUS.

We hear and read a deal about air being "killed" by coming into contact with surfaces heated to a very high degree (as are those of most furnaces and stoves); being "robbed of its vitalizing power," etc. If these phrases have any exact meaning, it would seem to be that such heated surfaces absorb oxygen from the air, and thus diminish its capacity for depurating the blood of the lungs into which it may subsequently be drawn. But careful experiments have demonstrated that iron heated to such degrees as 600°, 700°, or even 1,000° Fah., absorbs but a very minute amount of oxygen, not enough to alter the proportion of that gas in the air submitted to such contact. Sometimes it is said that the heated iron burns the organic particles in the air which passes it, and thus renders them more noxious. But if such burning really occurs, should not its effect be to disinfect the organic dust in question? It must be remembered that one of the most efficient methods of disinfecting clothing is to submit it to high temperatures, that of boiling water being found sufficient, although it is less than one-third of the temperature of many of our heating apparatuses. It is true that we get through our hot-air inlets the products of such imperfect combustion, which, however small in amount, are offensive. Is it not probable that much of the offensive odor often noticed in air from very hot furnaces is due to the action of this air, after its temperature has been reduced in the pipes, on collections of dust, etc., in the bends of these pipes, and in the registers? It reaches these at a temperature short of burning or scorching (which might disinfect), but quite high enough to hasten decomposition.

Nevertheless the evil of highly-heated surfaces in this connection is real, if they be surfaces of cast-iron; but it does not consist in their robbing the air of any thing, but in their adding to it certain poisonous gases (notably carbonic oxide and certain compounds of sulphur) which are now well known to pass through cast-iron when heated to or above a point just below redness. The fuel which generates them most rapidly is well known to be anthracite coal, which is the fuel ordinarily used in stoves and furnaces in the Eastern States; indeed, it may there be said to be almost the only fuel for these heaters. It is therefore of very great importance that the temperature of the hot-air chamber of cast-iron heaters should not closely approach the point of "red heat," at which it begins to be pervious to the dangerous products of imperfect combustion. And it is probably safer that no hot-air chamber — of whatever material — should exceed the temperature named. To this end, the burning fuel should not come into contact with any part of this chamber, which should be amply vaulted; and an abundance of air should enter from the cold-air duct — much more than is usually admitted to furnaces — in order both to keep down the temperature of the hot-air chamber, and to insure a pressure from thence into the fire-chamber rather than the reverse.

TEMPERATURE AT WHICH AIR SHOULD BE INTRODUCED TO ROOM.

It is matter of common experience, that this temperature varies very considerably with different kinds of heating apparatus, and with the same apparatus under different managements. It rarely falls below 100°, and as rarely exceeds 175°. It is of course desirable that the temperature at the point of introduction should differ as little from the standard temperature of the room as is consistent with maintaining that standard; otherwise the seats near the inlets must be uncomfortably warm. This desideratum is best attained by introducing large quantities of air at the minimum, rather than small quantities at the maximum temperature, and by introducing them by as many different inlets as is practicable. We are so accustomed to blasts of hot air from our inlets, where it is common to find the iron-work so hot that it will burn the hand, that we are inclined to suspect the efficiency of any heater which does not present this phenomenon. But the true test is the temperature of the room in all its parts, and this may be satisfactory when the temperature at the very inlet does not exceed 70° to 100° Fah. At a temperature thus low, much more fresh cold air can be admitted to the heater than is possible when a higher temperature is demanded at the hot-air inlet; and, entering at a less velocity, it imparts a greater proportionate sense of warmth than is given by a hotter but more rapid current.

SIZE OF OUTLETS AND INLETS.

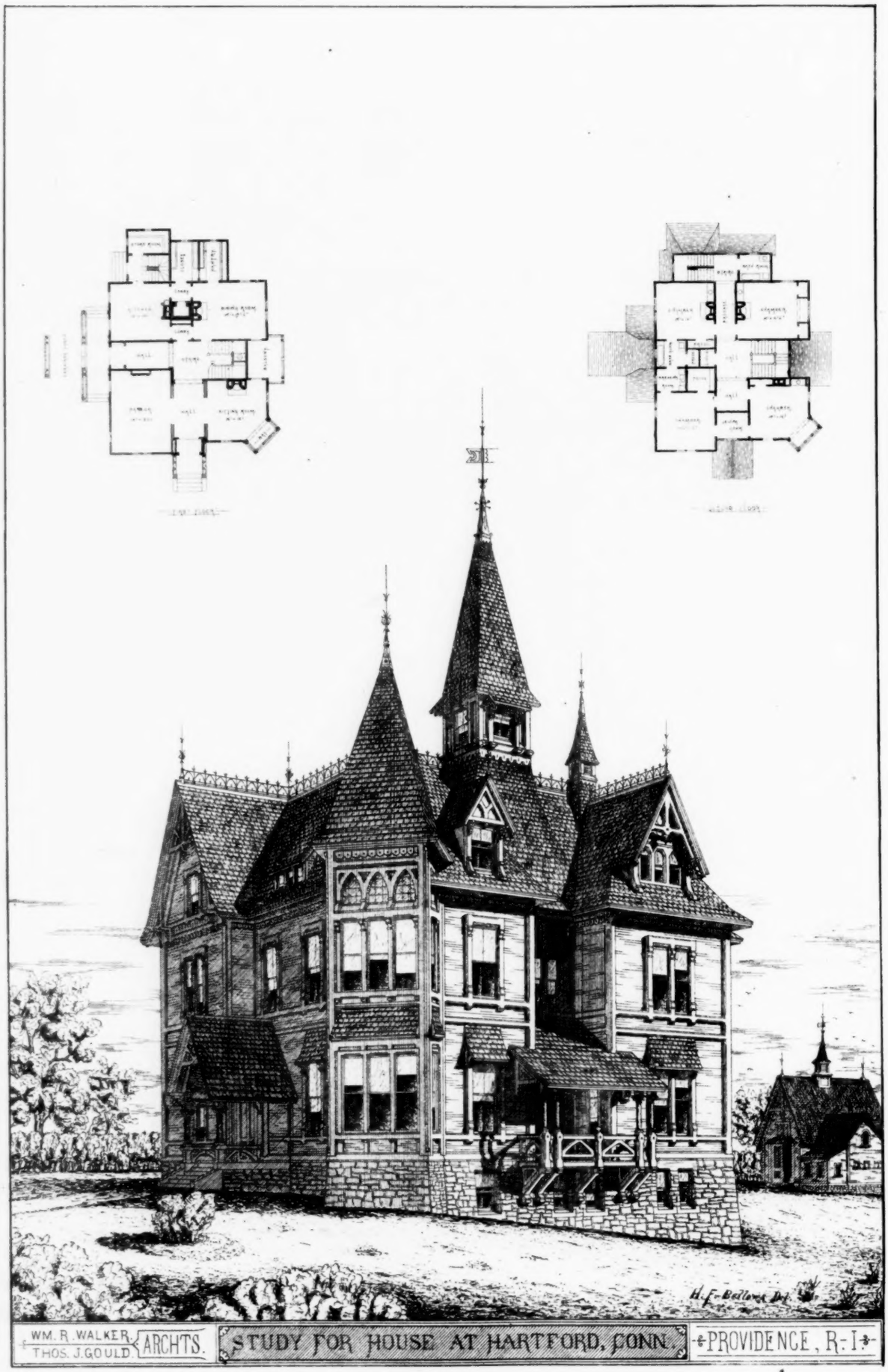
Such authorites as Park and Bose fix the area of outlets at from 21 to 24 square inches per head in rooms of proper capacity. Bose estimates the proper velocity of movement at outlet to be 2.33 feet per second. In the Boston City Hospital the operating theatre accommodates 240 persons, each having a supply of 700 cubic feet per hour (and a space of 2.29 cubic feet); its aggregate outlets have an area of 12 square feet, which is 7.2 square inches per head. There is "a notable absence of ether odor" while operations are going on. But here the minimum velocity at outlet is 3.33 feet per second, and in the chimney 5 feet per second. English Barrack Commissions require one square inch outlet for every 50 cubic feet in room. In our schools of 250 cubic feet space per head, this standard would require 5 square inches outlet per head. It seems very probable that a schoolroom with as much cubic space per head as this theatre, would be satisfactorily ventilated by outlets giving 7 square inches per head and a velocity of 2½ feet per second, provided it were faithfully flushed between and after sessions by open windows. At this rate the outlet area for 50 pupils would be 2.43 square feet.

The inlets may with safety be somewhat smaller than the outlets, since if air be withdrawn in sufficient quantities, it is certain that enough air will enter to supply its place; if not from the heating apparatus, then through minute cracks around windows and doors and through the very walls. Experiments with rooms in actual use show that in some instances three and a half times as much air escapes from the outlets as enters through the inlets provided as such (see Wilson's Hand-book of Hygiene, etc., p. 115); a fact which seems to the writer to teach most forcibly the double lesson that we can secure all the fresh air we need in our houses if we provide sufficient and efficient outlets for foul air, and that this fresh air will enter cold if we do not introduce it warm. And as a corollary to this, we infer that the common practice of nearly closing the so-called "cold-air box" to a furnace is as vain as it is mischievous.

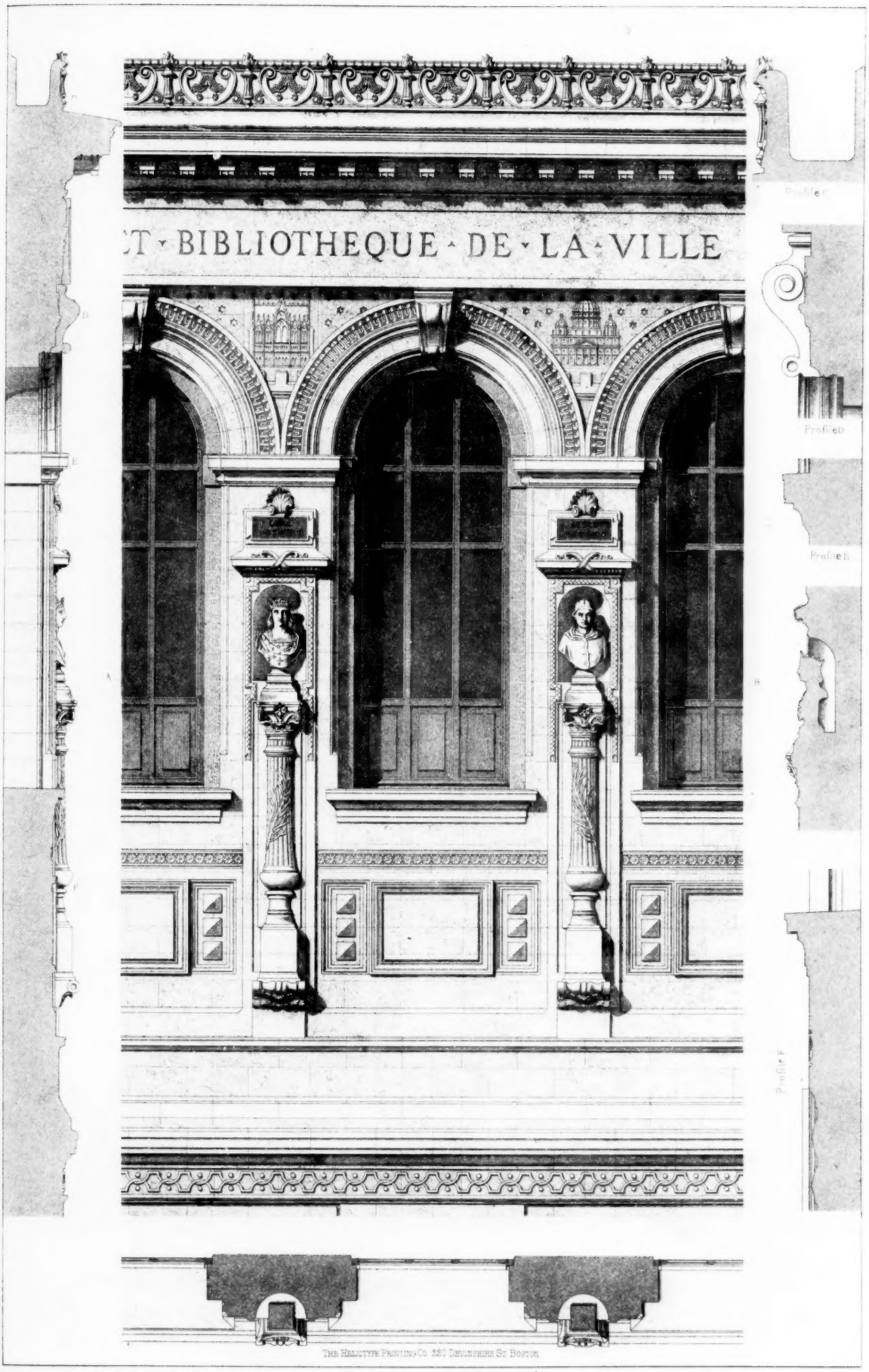
SITUATION OF OUTLETS AND INLETS.

It being a fact indisputable (though by no means generally recognized in practice) that air cannot be continuously introduced into a room from which no air escapes or is withdrawn, let us first consider what is the best place at which to withdraw the vitiated air. The most desirable place is certainly that at which it is first vitiated, i. e., at the part of the room where the occupants are, the bottom of the room, as represented by a horizontal section not more than four feet above the floor. Within this space it is that

DESIGN FOR
JOHN SHILLITO & CO'S NEW ESTABLISHMENT
—RACE ST. CINCINNATI—

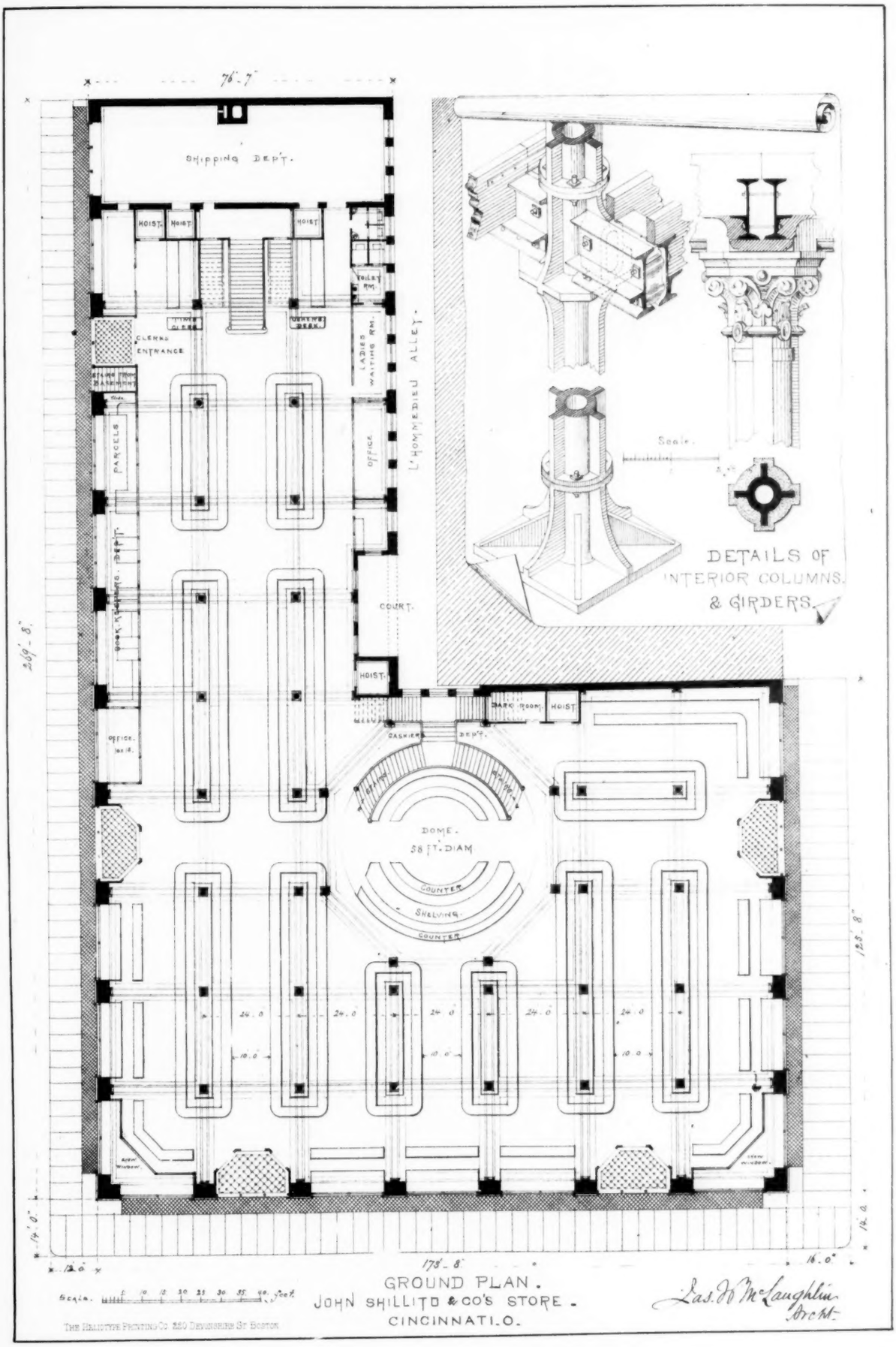


THE HELIOTYPE PRINTING CO. 340 DEVONSHIRE ST. BOSTON



THE HELIOTYPE PRINTING CO. 330 DEVONSHIRE ST. BOSTON

DETAILS FROM THE FAÇADE OF THE SCHOOL OF FINE ARTS, AT MARSEILLES FRANCE.
M. ESPÉRANDIEU ARCHT.



GROUND PLAN.
JOHN SHILLITO & CO'S STORE.
CINCINNATI. O.

Jas. W. McLaughlin Arch't.

THE HELIOTYPE PRINTING CO. 330 DEVONSHIRE ST. BOSTON.

all the exhalations from the occupants start, the expiration, the perspiration sensible or insensible, the effluvia from wet or dirty clothing and skins, the stench from filth on shoes and on the floor. Within this space, too, rises whatever dust is raised. How desirable, then, to withdraw it within this space before it mixes with and fouls the purer air above! Moreover it is within this space that the coldest air of the room is found, and especially about the feet of the occupants. If the foulest and the coldest air can be withdrawn together, there is an obvious gain in doing so. Again, it is within this space that we most want fresh and warm air. Yet the foul-air outlets are usually placed near the ceiling, thus securing the contamination of all the air in the upper two-thirds of the room by the passage through it of the foul air of the lower third; securing also the loss of much heat by providing for it an escape from the top of the room, where it is of course greatest. Of the practicability of the so-called downward method of ventilation we have abundant and familiar proof. In every open fireplace, with a good draught, we all recognize a ventilation so satisfactory, as regards the removal of foul air, that furnaces would never have been introduced into our houses if the heating capacity of the open fire had equalled its power of withdrawing bad air; and in connection with every variety of heater this system of downward ventilation is constantly coming more and more into favor. It is applicable whether the warm air be let in at the floor, at the ceiling, or at any intermediate point.

In the case of rooms having no warm room beneath, it has the further advantage of warming the space beneath the floor by the current of warmed air passing through it on its way to the common ventilating shaft. The foul-air outlets then may be placed in whatever portion of the lowest third or quarter of the room is found most convenient, the floor itself being, as in the case of inlets, the least desirable part of this space, on account of the readiness with which dirt and litter fall into openings in the floor. It is of course desirable to multiply the outlets, and thus avoid draughts, and secure the withdrawal of all foul air as near as possible to the point where it is generated. An excellent method is that of the so-called Ruttan system, viz., to set off the "sur-base" (mop-board?) a few inches from the wall, and cover the intervening space with perforated metal.

For rooms where in warm weather no motive power is provided in the ventilating shafts, it is well to have outlets in the upper part of the room also. And the same is true of evening-schools, where the heating and vitiating influence of gas-light demands a special provision. The shafts into which the outlets lead should not be in or directly against an outer wall, especially on the side of prevailing winter winds, because experience shows that the outer atmospheric pressure is sometimes powerful enough to force cold air through the walls into shafts thus placed, and to set up a current of cold air through them, thus converting outlets into inlets.

MOTIVE POWER.

The delusion that if channels suitable for the movement of air are provided, the air of a building will move through them, and always in the right direction, still lingers in the public mind; and it is still necessary to point out and emphasize the fact that such channels are quite useless unless some motive power is provided to draw the air into and through them. At the present day it may be taken for granted that heat is the only motive power practically available for this purpose. It may be applied on the inside or the outside of a shaft: within, by a fire, a stove, a gas-jet situated at whatever point of the shaft is found most convenient, or by a smoke-flue carried up within it; without, by placing the shaft in contact with a heated flue, or even in its interior. By some such means we must secure throughout the whole length of our ventilating shafts a temperature considerably above that of the outer air, and must maintain it during as many hours of every day as the room is in use. Such shafts must of course be of non-inflammable material, and must be smoothly and nicely finished on the inside, — which is seldom done, — in order to reduce friction to a minimum. To the same end their angles and turns should be as few and as gentle as possible. It is surprising that use is so seldom made of gas-jets to heat foul-air shafts. Their heating power is much greater than is generally supposed, and the ease with which they are put into or out of use would seem to commend them. One cubic foot of gas can be utilized to remove one thousand cubic feet of air. An ordinary burner consumes nearly three cubic feet of gas per hour, and is therefore equal to moving about three thousand cubic feet of air per hour, thus providing ample ventilation for four scholars. In the case of small schools in localities not supplied with gas, sufficient heat might be secured by means of kerosene lamps of the "safety pattern" hung within the shaft.

HEATING APPARATUS

may be divided into those which warm only the air already in the room, and those which warm fresh air constantly introduced from without. All of the former class are inadmissible, be they close stoves, close steam-pipes, close hot-water pipes, or gas stoves, for the sufficient reason that they warm poisonous air. Not all the latter class are admissible. Some of them allow carbonic oxide and sulphur compounds to pass through the red-hot iron walls of the combustion chamber into their hot-air chamber; others are so constructed that, after a few months of use, their joints allow the same gases to leak out; and very many are so arranged with checks to the draught in the smoke-pipe, either by damper valves or by ill-arranged admission of cold air, as to obstruct the escape of the products of combustion through the proper channel, and throw them back into the cellar, thence to permeate the whole house.

One of them, the ordinary open fireplace, is inadmissible for school use, because of its inefficiency and wastefulness as a heater, and because, in the very efficiency of its action as a ventilator, it draws into the room cold air (perhaps foul air) at every crack and pore. There are, however, several excellent varieties of fire-place made with an air-chamber behind and above the fire-chamber, into which fresh air is admitted from without to issue warm into the room in large quantities. In this manner the advantages of radiated and of conveyed heat are combined, while the excessive action of the open fire-place as a ventilator is moderated. Such fire-places might be used with advantage in small schoolrooms, supplying as they do ventilation without other special apparatus. Certain open stoves, constructed on a similar principle, possess in a still greater degree all the advantages of these fire-places, because they can be placed in any part of the room, and connected with the chimney like the common close stove. With one (or more) of these we obtain radiated heat, good heating power by conduction, downward and efficient ventilation, together with increased circulation of the air within the room, and all reasonable economy of fuel.[1] They cannot advantageously be used in very large rooms, or in many rooms in the same building.

We repeat that no heater is admissible which does not introduce large quantities of *warmed* fresh air. This can be done with pipes heated by steam or hot water, with many varieties of the hot-air furnace, differing in plan, in material, and in innumerable details, and with the open fire-places just described. The material of which these furnaces are made is not a matter of indifference; and in the light of his own information and experience, the writer gives the preference to soapstone and fire-brick (excluding all iron heating surfaces), next to wrought-iron. Cast-iron he places last, as demanding very great care in construction and in management to make it secure against the permeation of carbonic oxide, etc. Furnaces made of soapstone and fire-brick yield a mild and most agreeable heat, can be made and managed at as little expense as any large metal furnaces, and appear, in the somewhat limited trial which has been made, to be quite as secure against the escape of noxious gas as any heater of wrought-iron.

The question of fuel seems so certain to be decided by economical considerations, that we will only say here that anthracite coal is probably the least satisfactory fuel from the sanitary point of view.

SITUATION OF INLETS.

The situation of the inlets for warm and fresh air seems to the writer a matter of less importance than the situation of the outlets, because the fresh air is certain to move toward that part of the room from which air is withdrawn. Against the usual practice of placing them in the floor, there are two strong objections: first, as before stated, because they there become receptacles for dirt and litter, which not only obstruct them, but tend to foul the air at its entrance by collecting in the register itself, or at the bend of the pipe nearest it, where they lie heated to a degree that is sufficient to favor decomposition; second, because inlets in that situation peculiarly expose the scholars to disagreeable blasts of air. It is usually the case that the whole floor space of a schoolroom is needed for constant use. But the close neighborhood of a hot-air inlet is neither a comfortable nor a desirable place for any child to be seated. Moreover, in that situation, the heat they admit probably exerts less effect in warming the walls than it would from any other situation. Wherever placed they should be as numerous as is consistent with the practical solution of the problems of construction, in order to secure the most rapid and equable distribution of heat; and they should be so disposed in regard to the outlets as to avoid the misfortune of a direct current from inlet to outlet.

SUMMARY OF CONDITIONS REQUISITE TO SECURE GOOD VENTILATION AND HEATING OF SCHOOLROOMS IN THE NORTHERN UNITED STATES.

1. Air space of at *least* 250 cubic feet per head for oldest.
   " " " 175 " " " for youngest.
2. Floor space of at *least* 20 square feet per head for oldest.
   " " " 14 " " for youngest,

on the supposition that room is 12 feet in height.

3. Entire air of room to be changed 2½ to 3 times per hour.
4. This to be done by downward ventilation by exhaustion, the motive-power being heat in a shaft or chimney.
5. Outlets to be in proportion of seven square inches per head, inlets somewhat less; both as much distributed as is practicable, and neither to be in the floor.
6. Outlets to be somewhere in the wall within two feet of the floor, and entering a duct (or space) beneath it. Inlets anywhere except in the floor.

[1] F. O. H. stove.

7. Ducts and shafts for air — whether foul or fresh — to be as direct as possible, tight and smooth within.

8. An ample shaft or chimney, in which all the exhaust ducts end, heated to furnish motive-power equal to maintaining a velocity of 2½ inches per second at the outlets (of the rooms).

9. Heating apparatus of ample size and very freely supplied with pure cold air for its hot-air chamber; its smoke-pipe to be without valve or damper for checking the draught.

10. Temperature of room to be maintained between 64° and 68° Fah. in all parts.

11. Room to be flushed with outer air at least once a day by open windows.

12. In summer, outlets in upper part of room are preferable; and in the evening schools the same are important as adjuncts.

THE ILLUSTRATIONS.

HOUSE AT HARTFORD, CONN. WILLIAM R. WALKER AND THOMAS J. GOULD, ARCHITECTS.

(37 Weybosset Street, Providence, R.I.)

THIS house is now in process of erection, at the corner of Asylum Avenue and Woodland Street, Hartford. The grade of the lot falls from front to rear of house sufficiently to bring the basement-story in the rear entirely out of ground. The underpinning is of Longmeadow brown stone, rough-split surface, with hammered margin-lines at corners and window-openings, laid in rubble-work. The roof is covered with Brownville black slate.

JOHN SHILLITO AND COMPANY'S STORE, CINCINNATI. JAMES W. McLAUGHLIN, ARCHITECT.

(46 and 47 Johnston Buildings, Cincinnati.)

This structure, now in course of erection for a retail dry goods establishment, has a frontage on Race Street of 173 feet 8 inches, by 269 feet 8 inches on George Street, and 125 feet 8 inches on Seventh Street, covering an area on the ground floor of about 33,000 square feet. The basement has a greater surface of floor, being extended under the sidewalks on all sides. Beneath is a sub-cellar, under the entire building, for storage, 25 feet below the street level. The entire floor space covers six and one-half acres. Externally, the building will be six stories above the street, being 113 feet from the sidewalk to the top of the cornice. The walls are faced with Philadelphia pressed brick, laid with black mortar, the wrought work being of Buena Vista (Ohio) freestone. The principal story will be 20 feet 6 inches in the clear, the second story 16 feet, and the remaining stories 14 feet each. With the exception of the rear portion, or shipping department, the entire space of each floor will be open, and the view unobstructed, as the shelving is but 4 feet 6 inches high. The dome, 58 feet in diameter, extends from the first floor to the skylight above the roof. There will be three passenger elevators, and two for freight. The entire building will be heated by steam.

SCHOOL OF FINE ARTS AND CITY LIBRARY AT MARSEILLES, FRANCE. M. ESPÉRANDIEU, ARCHITECT.

We give this week details of the façade of the School of Fine Arts at Marseilles, which we published last week. Both illustrations are taken from the *Revue Générale de l'Architecture*.

THE PARIS MASON.

IN a recent article upon "The Masons of Paris," we perhaps led those of our readers who are not closely acquainted with French work and workmen to confound the *maçon* with the English mason. Among our neighbors masonry includes all construction composed of stone or rubble, of brick, mortar, or plaster. The ordinary *maçon* builds a brick wall; fills in a wooden partition, or he plasters both; he imitates brick on a plaster surface, and runs a cornice inside or outside a house, with equal ability and indifference. He makes and lays *béton* or concrete; builds an ordinary stone wall; carries and hoists freestone, rubble, brick, or mortar; raises or puts together common scaffolding. The foreman of the *maçons*, called the master-companion, is the recognized superior of all the workmen of all trades engaged upon a building. Over the larger part of France the *maçon* is as common as the bricklayer is over the larger part of England; a great deal of brick-work of the more difficult kind has been done in Normandy, and even in Paris, by Englishmen, simply because there was only the mason to do it; and his notions, both of Flemish and English bond, were obviously of a crude character. In France, external walls are now generally composed of soft limestone blocks embracing the entire thickness of the wall; and party-walls are of small cubes of freestone, squared and dressed roughly, and laid often in plaster. Brick is sometimes used in the chimney flues, and the chimney-shaft above the roof is often entirely of brick. But the *briqueteur* is, like his name, often an importation. In fact, the best brick buildings executed in the south of France during the middle ages are to be found in the neighborhood of Toulouse and of the Agenais, not far from the original province of Limousin, whence the common kind of *maçon* has acquired his name, though in these days not always by right of birth. Not that the division of labor amongst workmen is less in France than in England: on the contrary, it is much greater, for in the first named country the general contractor — the farmer of petty tradesmen, and capitalist-employer of labor — is almost if not entirely unknown. There the uninterrupted use of stone as the chief constructive material has preserved to the *maçon* his pre-eminence in the building fraternity, and the original nomenclature has been handed down to the present day. In the book of Etienne Boileau (thirteenth century), the *maçons* and *tailleurs de pierre* are mentioned together, and defined differently, or rather with the distinction which now marks their labors and duties. In the larger part of England the comparative scarcity of stone, and the employment, for two hundred years at least, of brick as the chief constructive material, have caused the stone-cutter to be not only a specialist, but also a luxurious adjunct of the building trade.

The designation of the different workmen employed by the contractor of *maçonnerie* is very varied, and the pay of each is determined by the nature of the duties performed. The rough walling and other ordinary work is done by the "*limousin*," whose wages amount to hardly a franc a day more than the assistant, or, in mediæval phrase, the apprentice of the *maçon*. The last named receives almost as much as the stone-cutter; he is hardly ever to be met without his assistant, who fetches, mixes, and hands him his plaster, and who keeps him supplied with *moëllons* or bricks, as the case may be. The "*tailleurs de pierre*" are simply the cutters or rough moulders of freestone, that is, of *pierre de taille*, both hard and soft. They seldom mount the ladders; they remain under cover or in the open yard of a building in course of erection. These men prepare the blocks after they have been sawn into a convenient and necessary size or height of course; they square the edges, knock off the soft and perishing excrescences, smooth the face which is to be seen in elevation, dress the beds, and rough out the moulded profiles where directed. Only when the stone is exceptionally hard are the mouldings finished before fixing; with soft stone like that used in Paris, the mouldings are cut after the façade is put together. Such mouldings are consequently intrusted to a superior description of workman, called a "*ravaleur*," partly because he reveals out of half meaningless forms what the architect intended to express; and the work of cutting the different mouldings and ornaments upon the face of a wall is called the *ravalement* — the carved or sculptured portions being reserved for the eventual chisel of an artist who justly arrogates to himself the title of sculptor.

When a block leaves the cutter's hands it is generally carried on a two-wheel cart by a coterie of men and youths called "*bardeurs*," and it is raised to the required level by a crab, or some more recent engine of the kind. It is then taken in charge by the "*poseur*," who is assisted by a "*contre-poseur*." Two other workmen, the "*pinceur*" and the "*ficheur*," are close at hand, — the one wielding an iron lever, the other a metal blade with a jagged, toothed edge, — who assist respectively in rolling the block along the rising wall, and in spreading mortar or plaster between the joints. Over all these men, who cut, carry, raise, fix, joint, and ultimately mould freestone, there is a foreman, who draws, under the direction of the architect, the several constructive details to their real size either on a plastered wall or an upright surface of planks, and who prepares the templates, which are usually made of laths, although lately zinc has been sometimes employed. This man, intrusted with what is called the *tracé d'appareil* and the *coupe de pierre*, is the "*appareilleur*." He and the master-companion are the two most important officials engaged upon a French building, and they are inferior only to the inspector or clerk of the works, who is generally a young architect. We refer, of course, only to large works, for in ordinary Paris houses a clerk of the works is rarely seen. There the master-companion and the *appareilleur* take their orders usually direct from the architect or from one of his more advanced pupils. — *The Builder.*

ST. JOHN, N.B.

THE traveller who leaves Boston by steamer on a fine clear morning, and lands at St. John on a foggy evening, cannot fail to contrast the two places, much to the detriment of the latter. Nor is this difference due entirely to the fog: even in clear sunshine there is much to give one an unfavorable impression of the place. There are streets in the northern part of the town that look exceedingly "Irish"-like, — that remind one of some of the by-ways in Dublin, — places where the houses seem to have been painted only once since they were built, years ago; but age cannot be said to have rendered them picturesque. Dirty water thrown out of the houses stagnates in the gutters, and in general sanitary laws seem neglected. There are to be seen the same dirty green-grocers' shops, with windows of varied contents, as are found in towns of greater antiquity in the Old Country. You will see wonderful pieces of sculpture at shop-doors; wooden "tars," or Indians, with bundles of cigars in their hands, are frequent subjects.

The old church-yard adjoining King's Square is a shady place, enclosed by a wooden fence, such as might be found round a farmer's garden. A plain printed notice warns the visitor to "keep off

the grass;" but if he seeks to rest, no seat will he find. Some ingenious person has sawn sugar-barrels in sections, stuck them on the top of some tree-stumps, and filled them with flowers; the wood-work painted green, to form less contrast with the surroundings — a happy idea!

The Yankee who comes here from the United States, where, as a rule, the towns and cities are orderly and cleanly kept, and some attempt is made by art to render them attractive, is struck with astonishment. Still further is he amazed when he crosses the St. John River, not in a comfortable, cushioned saloon-steamer, but in a dirty tub of a vessel, whose upper deck lets water through on rainy days — and which is badly managed no less than uncomfortable.

Of the thoroughfares, little need be said: the citizens tell me the "great traffic" at present going on explains their dirty appearance. I am a loyal subject of Queen Victoria, and would fain have given a brighter account of this part of the Dominion: yet the truth must be told.

Concerning the rebuilding, the amount done since the fire is truly marvellous. The business portion, near where the fire originated, and along the wharves, has been the first to raise its head above the ruins. Many houses, some of brick, and others of timber, are being erected in other parts.

In the rebuilding of a city, it is a matter of regret that more similarity of style cannot be carried out. Here, owing to the great rise and fall in many streets, difference in style is even more distinctly marked than on level ground. All buildings, however, are built of red brick, and nearly all are faced with pressed brick of good quality, obtained from Boston or Philadelphia, — some with freestone finish. Ornamentation in black or colored brickwork has been attempted, not always successfully; and the vile custom of putting up cornices of zinc or galvanized iron, painting and sanding them to imitate stone, has been imported here from the States. The adoption of flat roofs, covered with asphalt or tin, detracts considerably from the appearance of the buildings, rendering the sky-line any thing but pleasing.

The offices of the Western Union Telegraph Company (Mr. Merry, architect) were among the first to be built. The design is characterized by a free use of black bricks in patterns; the general opinion being, that the amount of black brick disturbs the repose of the design. On the opposite side of the street is a building of red brick, with a few panels of pure white enamelled brick which form a glaring contrast with the red.

A block of buildings erected for a Mr. Marshall is marked by care in proportion, and in the use of black brick. Messrs. McKean & Fairweather, the architects of this building, have several important works in embryo, including the Custom-House, Savings Bank, Victoria Schools, Masonic Hall, and a large block for the "Daily Telegraph."

The new Post Office has been intrusted to Mr. Stead, and will be a very appropriate design.

Messrs. Smith & Dunn are the architects for a large block of stores and warerooms in course of erection on Market Square for Messrs. Daniel & Boyd. The plans of St. Andrew's Presbyterian church by Messrs. Langley, Langley, & Burke, architects, of Toronto, are on view for the purpose of receiving tenders. The length of this building, which includes schools and vestry-rooms, is externally about 150 feet by 79 feet. X.

THE SOOCHOW PAGODA.

Now that the Porcelain Tower at Nanking exists no more, having fallen a victim to the madness of the Tai-pings, the Pih-she-t'ah at Soochow enjoys the distinction of being the largest pagoda in China. It is a fine specimen of this curious species of edifice, and of course a magnet to the traveller in this part of the world. The city of Soochow, where this pagoda is situated, is about seventy-five miles distant in a north-westerly direction from Shanghai, and is reached after a twenty-four or thirty hours' sail along the many canals that intersect the whole region hereabouts and form the universal means of communication. The city has long been famous for its wealth and splendor, the people having a proverb that "Heaven is above, and Soochow and Hangchow beneath." It was deprived, however, of much of its prosperity and beauty by the rebels, who laid perhaps the larger part in ruins. Known among foreigners as the "Paris of China," it has felt as severely as Paris has the savagery of fanaticism and mob misrule. The population has declined from a reputed two millions to barely one-fourth of that number, while weed-grown mounds, breaking the monotonous level in every direction, are mute but significant testimonies to the horrors of the Tai-ping occupancy.

There are five pagodas within the walls of Soochow, but the glory of the town is the great Pih-she-t'ah, which raises its ambitious top as if, heedless of Babel and her fate, it were striving to reach the heaven overhead. The internal plan is simple and effective. The structure is double, the inner column being filled with niches where idols sit and accept the incense of the devout. The staircases wind, in easy and comfortable stages, between the two divisions, while openings at every story to the galleries afford light and air. The floors, like the walls, are of large black brick, very hard and serviceable, and, in the more frequented passages, take a glossy and almost porcelain polish from the friction of numberless sandals. Projecting from the tower, at each floor, is a wooden gallery shaded by the peaked roofs, bell hung, which distinguish this curiosity of architecture. From these verandas extensive views of the city and environs are obtained, some very beautiful as thus seen from a safe distance.

But the galleries are shaky things, and it is safer to leave them and their views, and content ourselves with a further examination of the pagoda. Arrived at the eighth story — there are nine in all — we notice the immense beam that, founded in the solid masonry, rises far above the tent-shaped roof.

Were the pagoda in a more enlightened land, the visitor could not walk for treading on young persons selling illustrated guides; but China is not up to that point in civillization yet. In the absence of such compends of information, we gathered a few stray facts for ourselves. From the ninth story to the pavement of the court we counted two hundred and thirty-five steps. Estimating these at an average height of eight inches, we get an elevation of one hundred and fifty-seven feet to the floor of this story, which with the dome-like roof and the spire which surmounts it, must add from fifty to seventy feet more, so that the total height cannot differ much from that of the Porcelain Tower at Nanking, which measures two hundred and thirty-six feet. The diameter, as paced on the first floor, a few feet above the level of the court, was found to be about sixty feet. This dimension gradually and symmetrically lessens as we ascend, until at the ninth story it is scarcely a half of that distance. The walls are from three to four feet in thickness, built very solidly of the brick we have mentioned and a coarse cement. The only pieces of woodwork apparent are strong braces connecting the double towers, and forming a foundation for the floors and the ornamental galleries. The stability of the structure is vouched for sufficiently by the fact that it has stood a thousand years in a land of typhoons.

It is easy, at least, to say a thousand years when speaking of China, and there is evidence to prove the very ancient character of the building. On one of the bricks in the highest story is an inscription which dates back to the reign of one of the Ming dynasty, some three hundred and thirty or forty years ago. This may be taken as the era of the completion of the pagoda, but its beginning belongs to a far earlier date. It is stated as historical that its erection was undertaken by three persons, the first a viceroy, the second a private citizen who beggared himself in the work, and the third and successful patron, a Loo-Chooan prince. Another account holds that the work was begun by a minister to show his gratitude for imperial favors; but it soon consumed his property, and was completed by the emperor, who thus paid for his own compliments. How expensive he found it we have no means of knowing; but it is said that the Nanking pagoda cost more than three millions of dollars, and even at Asiatic compensation for labor, it is reasonable to consider that the Soochow tower must have cost a sum approaching this. Picturesque as the pagodas are, and greatly as they help out the landscape, it is to be regretted that pride and piety in the golden epoch of China did not take a more practical form. — *Correspondence of the N.Y. Evening Post.*

LINCOLN CATHEDRAL.

ABOUT three years ago (says the Lincolnshire *Chronicle*) some alarm was entertained relative to the state of the south-west tower of our noble cathedral. There were not wanting "evil prophets" to foretell the early collapse of the tower, together with a considerable portion of the imposing west front. These "evil prophets" asserted that the foundations had given way, that the tower had sunk to a great extent, and that consequently there were well-founded reasons for supposing that the structure was in a dangerous condition. On the other hand, there were confiding bodies who could see no occasion for fear, their satisfaction being grounded on the principle, that, as the work had stood for some hundreds of years, there need be no doubt as to its capability to withstand the storms of many years to come. Happily, the Dean and Chapter were equal to the occasion; and, being fully impressed with the importance of preserving in its fullest entirety the grand old edifice which had been intrusted to their care, they instructed their architect, Mr. Pearson, to examine the affected portion of the building, and furnish a report thereon. After carefully investigating the matter, Mr. Pearson presented a report to the Dean and Chapter, pointing out the dangerous state of the tower, and suggesting the necessary remedies. It was, however, thought by certain authorities that Mr. Pearson had overstated the danger, and that the work was in a more satisfactory state than he had described it to be. The Very Reverend the Dean thereupon called in Mr. Barlow, C. E., to view the tower. Mr. Barlow fully indorsed Mr. Pearson's report, and further added that the matter had not been taken up a moment too soon. Accordingly, the Dean and Chapter instructed Mr. Pearson to proceed with the necessary work; and he secured the services of a practical clerk of works on the spot, who immediately set to work at the cause of the disaster. An examination revealed the gratifying fact that the foundations of the south-west tower were perfectly secure. Further investigation showed that the mischief existed in the space at an altitude of between 60 and 95 feet in the tower, and that the tower itself

was 9½ inches out of perpendicular, inclining southwards. It was ascertained beyond a doubt that the primary cause of the settlement was the bad construction of the Norman work at the point where the staircase narrows. As is well known, the towers were not originally designed to be carried to their present height, and the points at which the additions were made in the fifteenth century are easily discernible. It seems that the south-west turret was actually built upon a rubble arch, instead of a solid wall. This produced a settlement of the south wall, on account of the same not being able to sustain the increased weight placed upon it. The south wall was pierced with passages longitudinally, which tended to weaken it, and it therefore had not naturally the strength of a solid wall. Hence the settlement, which divided the wall into three portions; the two outer faces bulging outwardly, the middle portion being in the passage, and the fracture in many places was to the extent of four inches. The fractures continued to increase; and it is somewhat marvellous that the tower has kept up so long. It was also discovered that, by the settlement of the works in question, a portion of the west front was being pushed out to the extent of about five inches, and that the mischief was gradually increasing. Active operations to counteract this unsatisfactory state of things were commenced in July, 1875, and are still proceeding. An immense work of "shoring" has been necessitated; and the whole system seems to have been very carefully arranged. The works present a complete maze of timber; and it is evident that every precaution has been taken with a view to prevent mishaps, and prepare for any emergency. One thing is evident: had the work not thus been promptly taken in hand, an "avalanche" of the south-west turret might have been looked for, in which case the loss, in an architectural sense, would have been a national one, and, at the same time, probably the lives and limbs of some of her Majesty's subjects might have been sacrificed. As it is, the action of the Dean and Chapter promises to give stability to the noble pile, and to hand it down to posterity in as perfect a state as possible. The work will necessarily take a considerable time before it is completed; but it is being prosecuted in such a manner as to leave no doubt that it will be brought to a thoroughly satisfactory termination.

NOTES AND CLIPPINGS.

STRIKE OF PLASTERERS AT BROOKLYN. — The plasterers and skilled laborers — numbering about one hundred — left their work on new Municipal Building, Brooklyn, last week, having struck because of the reduction of their wages. The brothers Thomas and William B. Lamb took the contract from the Brooklyn city government to erect that building, and then sublet it to Thomas B. Watson, a builder and plasterer. From the latter the plasterers have been receiving two dollars and fifty cents a day, and the laborers two dollars. They were notified that a reduction of twenty-five cents a day would be made in their wages; and a meeting of the Brooklyn Plasterers' Union having been held, it was decided to refuse to accept the new scale of prices. This is the third or fourth strike that has occurred among laborers on the new Municipal Building.

STONE FOR THE CHICAGO COURT HOUSE. — Great quantities of building stone are now being shipped from Blue Hill, Me., to Chicago for the new court-house; and there is but one handling of the stone between the quarry and Chicago.

THE GEORGIA STATE HOUSE. — Atlanta renews the proposition to give City Hall Square and build a capitol as good as that in Milledgeville, if it is selected for the capital.

THE INDIANA STATE HOUSE. — It is expected that about seventy-five designs for the new State House at Indianapolis will be submitted in the second competition.

IMPROVED SEWERAGE AT BOSTON. — The committee on Improved Sewerage have awarded contracts for the several sections of the sewer for which proposals were recently received. W. L. and Bruce Hoblitzell of Baltimore were the lowest bidders for section one, but subsequently withdrew; and the contract was awarded to P. J. Conlon of Jersey City, whose bid was $37,735. The same party also received the contract for section two for $33,705. For section one on Stony Brook, Miles Tierney received the contract for $25,255; and the South Boston section was awarded to Stephen Connolly & Sons for $21,622.40.

THE PEORIA, ILL., COURT HOUSE. — It is said that the Board of Supervisors have by a vote of sixteen to seven discharged the architects of the court-house, Messrs. Wilcox & Miller; the action being based on the minority report of the committee which was appointed at the instance of Mr. Wilcox, to investigate the charges which he had made against the contractors.

HEATING CITIES BY STEAM. — A company has been incorporated in Columbus, O., with a capital of $150,000, which states that it is ready to furnish steam for heating houses and running machinery in any part of the city.

DEEP BORING AT ST. LOUIS, MO. — In boring the artesian well at the Insane Asylum, St. Louis, the auger penetrated 3,800 feet, going through 200 feet of coal measures, 500 feet of sub-carboniferous limestones, 1,000 feet of Devonian, and 2,000 feet of upper and lower silurian, and in the bottom cut a brown ferruginous sandstone, supposed to be of Potsdam age.

HOUSE MOVING EXTRAORDINARY. — An Oswego County (N. Y.) man lately moved his two-story house on a train of four platform-cars from Sand Hill to Pulaski.

A CHANCE FOR FEMALE CARVERS. — Mr. Reuben E. Springer, who has given the city of Cincinnati a music hall and an immense organ, has given $500 in gold, divided into ten prizes, for the best designs in carving for the case of this instrument. The competition is open to all American women.

ACCIDENT TO A BRIDGE. — At twelve o'clock on the night of Oct. 6, the western abutment to the great iron bridge that spans the Missouri at Atchison, Kan., caved into the river, carrying the entire fifteen-foot wall and about seventy-five feet of embankment. A gradual sliding of work had been noticed for the past forty-eight hours, and Mr. L. L. Todd, superintendent of the bridge, had a force of men employed day and night, doing every thing that could be done to avert the disaster. A force of men had been at work tearing off the wall all day, that the long draw span might be cleared, and escape the danger that threatened when the wreck should come. They succeeded in swinging the draw clear at ten o'clock. At twelve o'clock the huge mass of masonry, and thousands of cubic yards of earthwork, the office and bridge approach, were hurled into the Missouri River. The damage has been confined exclusively to the abutment, and every thing else is safe.

A NEW OPERA HOUSE. — A new opera-house was opened in Leicester, Eng., recently. The building cost about $175,000.

OUR TONS. — "Could any thing be more absurd than our tons?" says the *Engineering and Mining Journal*. "In a copper works, for example, ore is measured and paid for by the (tribute) ton of 2,352 lbs. from the mine through the mill, till it comes out of the jigs, when suddenly it is transformed into a ton of 2,240 lbs. (the difference, perhaps, going out in the tailings), which is the ton of the roasting and smelting furnaces and of the teamsters. This continues till the copper is sold or carried over some roads, when the ton shrinks again and becomes 2,000 lbs. At the iron works there are still more tons, different from these; and on the railroads one will report the coal carried in tons of 2,240 lbs., and another connecting road uses the ton of 2,000 lbs. And in order to maintain the beautiful symmetry of our system, they of course rarely, if ever, state what kind of a ton is used in either case. Coal is mined and miners are paid by tons of various weights from 3,000 lbs. to 2,000 lbs. It is sold by tons of 2,240 and 2,000 lbs., and by tons running down all the way to 1,500 lbs. The use of the ton less than 2,000 lbs. is called cheating, but the large purchasers, those who buy from a car-load (6 tons) up, may get 2,240 lbs. to the ton; but if they buy from the same company's retail yard, they find the ton weighs no more than 2,000 lbs., if it does that. Coal is sold by bushels of 76 lbs. and 80 lbs., by barrels, loads, hogsheads, and other 'standards,' the weights of which depend originally on the fancy of the individual, and subsequently on 'immemorial custom.'"

AN INGENIOUS PRISON LOCK. — Mr. George Page of New Haven, Conn., who has invented a number of important improvements in locks, has completed a model of a lock for cell-doors in jails and prisons. This lock cannot be opened by a prisoner in his cell. There is one key-hole, as in any other lock. A little to one side of it appears a hole cut through the iron plate of the lock, back of which are movable plates which are of different colors — white, red, and black; and it is by an observation of these plates that the governor of a jail sees at a glance just how much a prisoner is locked up. By a spring in the edge of the lock it is made to effectually seal the door when a prisoner is placed in a cell, without the need of using any key. The turnkey, however, has a key, and on locking the door the little movable plate shows red. If all the cell locks exhibit the red movable plate, an inspector knows that every lock is closed. The governor of the jail, or some person in superior authority, has a master-key which fits into the same key-hole. He goes around the last thing at night, inserts his master-key, and, after it is turned, the red show-plate is automatically changed for a black one. When so locked, the turnkey cannot unlock the door with his key; he must wait for the governor of the jail to use his key. The idea is that though a keeper may be bribed, it would be harder to bribe the superior officer. If any prisoner should succeed in unlocking the lock of his cell, the pushing back of the lock-bolt starts off a loud bell-alarm concealed within the lock.

THE GREAT WALL OF CHINA. — The Great Wall of China was measured in many places by Mr. Unthank, an American engineer, lately engaged on a survey for a Chinese railway. His measurements give the height at eighteen feet, and a width on top of fifteen feet. Every few hundred yards there is a tower twenty-four feet square, and from twenty to twenty-five feet high. The foundation of the wall is of solid granite. Mr. Unthank brought with him a brick from the wall, which is supposed to have been made two hundred years before the time of Christ. In building this immense stone fence to keep out the Tartars, the builders never attempted to avoid mountains or chasms to save expense. For 1,300 miles the wall goes over plain and mountain, and every foot of the foundation is in solid granite, and the rest of the structure solid masonry. In some places the wall is built smooth up against the bank, or cañons, or precipices, where there is a sheer descent of 1,000 feet. Small streams are arched over, but on the larger streams the wall runs to the water's edge, and a tower is built on each side. On the top of the wall there are breastworks, or defences, facing in and out, so the defending forces can pass from one tower to another without being exposed to any enemy from either side. To calculate the time of building, or cost of this wall, is beyond human skill. So far as the magnitude of the work is concerned, it surpasses every thing in ancient or modern times of which there is any trace. The Pyramids of Egypt are nothing compared to it. — *London News.*